



UGANDA INSTITUTE OF INFORMATION AND COMMUNICATION TECHNOLOGY

FINAL EXAMS

ACADEMIC YEAR: 2025/2026

SEMESTER: TWO

PROGRAMME: DECE

YEAR OF STUDY: TWO

COURSE UNIT: INTRODUCTION TO MICROWAVE COMMUNICATION

COURSE CODE: ECE224

DATE: TUESDAY 23/06/2026

TIME: 2:00-5:00 PM

DURATION: 3 HOURS

ROOMS: 3.2 & 3.3

INSTRUCTIONS:

- i. This paper contains of Two (2) sections A and B**
- ii. Section A is compulsory and carries 40 marks**
- iii. Section B contains 6 questions, each with 20 Marks, Attempt only 3 Questions**
- iv. Show all workings where applicable**

SECTION A 1 (OBJECTIVES 10 MARKS)

1. Microwaves backhaul propagation is mainly:
A. line-of-sight B. ground wave C. ionospheric skywave D. acoustic
2. The main lobe of a radiation pattern indicates:
A. direction of maximum radiation B. direction of minimum radiation C. noise floor D. impedance
3. Beamwidth generally becomes narrower when:
A. antenna aperture increases B. frequency decreases with same aperture C. gain decreases
D. side lobes increase
4. A standing wave is caused by:
A. high reflected power B. high transmission power C. superposition of incident and reflected waves only noise D. only DC voltage in the antenna
5. attenuation is generally more severe at:
A. Ku/Ka bands B. HF bands C. audio frequencies D. DC
6. Fresnel zone obstruction primarily causes:
A. lower VSWR B. frequency increase C. higher antenna gain D. additional loss and fading
7. Rain attenuation is generally more severe at:
A. 60GHz B. HF bands C. audio frequencies D. the gamma ray region
8. In microwave communication links, when fading due to rain attenuation occurs, the techniques adopted for solving the problem would include.
a) Antenna replacement and feed correction b) amplitude trimming and phase correction
c) Polarization shifting and code diversity d) path diversity and frequency diversity
9. Ionospheric propagation is not possible for microwave because
a) Microwaves will be fully absorbed by the ionospheric layers b) there will be an abrupt scattering in all direction
c) microwaves will penetrate through the ionospheric layers
d) there will be dispersion of microwave energy
10. A yagi antenna is a directional antenna consisting of parasitic elements called
a) Only a Director b) with a reflector c) with one or two more directors d) with a reflector and one or more directors

SECTION A 2 (STRUCTURED 30 MARKS)

11. High-gain antennas normally have _____ beamwidth. (1 mark)
12. Microwaves backhaul systems commonly operate in the range _____. (1 mark)
13. Which antenna which provides circularly polarized waves? (1 mark)
14. Draw a sketch of a 6.5Vdc (1 marks)
15. What is microwave backhaul? (1mark)
16. Give two reasons why waveguides are preferred at high microwave frequencies. (2 marks)
17. Explain the significance of return loss and VSWR. (2 marks)
18. What happens when the transmitting and receiving antennas have different polarization? (2 marks)
19. Explain any three characteristics of RF signals. (3 Marks)
20. What do you understand by the term Radio frequencies signal (RF) (1 mark)
21. Explain the importance of impedance matching in microwave systems. (3 Marks)
22. State and explain five applications of microwave communication. (5 Marks)
23. Explain the following ways of propagation of electromagnetic waves and state one application (3 marks each)
 - a) Sky wave propagation
 - b) Ground Propagation
24. State the condition for maximum power transfer 2 marks
25. State three applications examples of microwave frequencies under the following categories
 - Radar 3 marks

SECTION B (ATTEMPT ANY THREE)

QUESTION ONE (20 MARKS)

A telecommunications company plans to establish a 25 km microwave backhaul link between two cellular towers.

- a) Explain the role of the microwave transceiver, antenna and transmission line in the system. **(6 marks)**
- b) Explain why Fresnel zone clearance is important. **(6 marks)**
- c) Recommend engineering measures that would ensure reliable operation of the link. **(8marks)**

QUESTION TWO (20 MARKS)

A microwave communication system is experiencing poor signal quality.

- a) Explain how the following are affecting signal propagation.
 - i. Reflection **(3 marks)**
 - ii. diffraction **(3 marks)**
 - iii. scattering **(3marks)**

- b) Explain the effects of the following on communication quality.
 - i. multipath fading (2 marks)
 - ii. Rain fading (2 marks)
- c) Recommend engineering solutions to improve the link affected by b(i) and b (ii) (2 marks)
- d)
 - i. Why are topographic maps useful in microwave communication planning? (2 marks)
 - ii. Why are elevated locations preferred for microwave communication towers and what obstacles may block microwave communication? (3 marks)

QUESTION THREE (20 MARKS)

Mtn Uganda limited would like to extend its network to Damba islands in Lake Victoria. To do so they need to extend coverage of their network from Nkokonjeru to Katosi by creating a tower at Katosi.

- a) Mention four factors to consider for proper link planning between Katosi and Nkokonjeru (4 marks)
- b) After the link was established between Katosi and Nkokonjeru it was realized that Received Signal Indicator (RSSI) was low. State four ways that this can be improved in order to have a stable signal (4 marks)
- c) A team of UICT DECE students were subcontracted to install the microwave antennas on the Nkokonjeru and Katosi mast. High 6 steps of antenna alignment procedure that you are going to follow. (6 marks)
- d) During antenna installations they are best practices that must be followed to the Quality test. Mention three dos and three don'ts (6 marks)

QUESTION FOUR (20 MARKS)

- a) Starlink applied to UCC to start operating as an internet provider. Explain how a phone can access internet through a satellite (3 marks)
- b) Uganda launched a satellite, what is its name and intended use (3 marks)
- c) State the reason for different uplink and downlink frequencies in satellite transmission (3 marks)
- d) They are 3 Kepler laws of planetary motions, highlight 3 important phenomenal issues described by these laws or state them (3 marks)
- e) State 2 types of Orbits and the type satellites commonly used in those Orbit (4 marks)
- f) What do you understand by FDMA and TDMA (4 marks)

QUESTION FIVE (20 MARKS)

- a) Governments spend lots of money to invest in military radars to protect the sovereignty of their nations. Explain how modern fighters do jets still avoid being detected by radar systems (4 marks)
- b) i) state two microwave devices that can be used in the transmitter section of the radar (2 marks)

- ii) What is the function of the duplexer in the radar system **(2 mark)**
- c) Radar systems are crucial for national defense, state four functions of radars (**4 marks**)
- d) Explain what you understand by Doppler Effect and state the type of radars that use Doppler Effect **(4 marks)**
- e) State the basic principle of operation of a Traffic Speed gun (**4 marks**)

QUESTION SIX (20 MARKS)

A telecommunications company plans to expand 4G/5G coverage to a remote region consisting of six towns. Due to mountainous terrain and the high cost of laying optical fiber, the company decides to deploy a microwave transport network. The network must support cellular backhaul traffic, provide high reliability, and maintain an availability of at least 99.99%.

During the planning stage, engineers identify the following challenges:

- Long distances between some towns requiring signal regeneration.
- Limited microwave spectrum availability.
- Risk of service interruption if a single network node fails.
- Expected traffic growth of 40% over the next five years.

Required:

- a)** Recommend the most suitable microwave network topology for this project and justify your choice. (6 Marks)
- b)** Explain the role of repeater stations in the proposed network and indicate where they would be required. (4 Marks)
- c)** Describe two frequency planning techniques that can be used to minimize interference between microwave links. (4 Marks)
- d)** Propose a redundancy and protection switching strategy that would help achieve the required network availability. (6 Marks)

END